

argumentative strategy – demonstrations that they could artificially produce structures with the same appearances as fibrils by, for example, coagulating the whites of eggs or gelatin with various fixatives. I will turn to the question of how scientists appraise claims about artifacts in the next chapter.

The pattern of claim and counterclaim concerning the reality of various proposed cytoplasmic constituents continued through the early years of the twentieth century. This period also witnessed further improvement in the light microscope and the techniques for using it, as well as the introduction of variations, such as the ultraviolet microscope and phase contrast microscope. Moreover, as is clear from a 1924 textbook edited by Edmund Cowdry, *General cytology: A textbook of cellular structure and function for students of biology and medicine*, it was a period in which cytologists were increasingly interested in figuring out the function of new structures and making connections to chemistry (though often frustrated by the limitations of available tools). In the following sections I describe in more detail what was being learned about cell membranes and three organelles – mitochondria, the ergastoplasm, and the Golgi apparatus – that would later become foci of inquiry using improved tools in the early cell biology of the 1940s and 1950s.

Cell Membranes (1825–1935)

Membranes are among the most important parts of cells, serving to organize other parts and functions. Not only is there a plasma membrane surrounding the cell itself, but also membranes enclose the cell organelles, including the nucleus. Although membrane boundaries can be readily seen in electron micrographs, they were not so easily distinguished with the light microscope. Much of the evidence for them in the nineteenth century stemmed from their role in selectively admitting substances into cells. Already in the late eighteenth century William Hewson (1773) had appealed to the ability of red blood cells to shrink or swell to argue that they were envelope-bounded vesicles. Hewson's research was not well known in the nineteenth century, however, and the presence of a barrier surrounding animal cells continued to be debated. Schultze (1861), as I noted previously, characterized a cell as a lump of protoplasm which acquired a membrane only in its senility.

One of the key types of evidence pointing to the existence of membranes was the phenomenon of osmosis, the movement of water in and out of cells until the substances dissolved in it are distributed equally on the two sides. During the period when animal cells were known as *globules* and reports of their existence may have been artifacts of chromatic aberrations, Henri